STIMULANT AND TOXIC EFFECT OF BIOMASS ASH DOSAGE IN POT EXPERIMENT

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Abstract: The ash which is originated from energetically use of biomass contain plant nutrients. For this reason the use of this by-product as a plant nutrient is suitable. In the course of burning some nutrients (N, S) exist from the system but other nutrients (Ca, K, Mg, microelements) are concentrated in the ash. The effects of higher concentration of potential toxic and essential microelements are depending on dosage. The agricultural use of biomass ash in small concentration works as a stimulant but higher concentrations have toxic effect on plants.
The effect of different biomass ash dosage were investigated in pot experiment on Ryegrass and White mustard. The optimal dosage was 16 t ha^{-1} in case of Ryegrass. Significant effect was not found on White mustard below 20 t ha^{-1}.

Keywords: biomass ash, pot experiment, ryegrass, white mustard

Introduction

The ash which is originated from energetically use of biomass contain plant nutrients. For this reason the use of this by-product as a plant nutrient is suitable. (Demeyer et al. 2001; Steenari – Lindqvist 1997; Zimmermann et al. 2010). In the course of burning some nutrients (N, S) exist from the system but other nutrients (Ca, K, Mg, microelements) are concentrated in the ash (Vance 1996). Micronutrient concentration is various of plant originated bioash. The potential toxic metal content of wood ash is characteristically low (Someshwar 1996). However, the uptake of essential micronutrient block by the high pH of wood ash (Ozolincius et al. 2007).
To examine the effect of wood ash on soil and vegetation Füzesi et al. (2015) conducted a small plot experiment. Within this framework they have been examining the composition of wood ash, the mobilization of its constituents, and its nutrient-supplying capacity. They have been studying the changes in the chemical properties of the soil as a result of the treatment, as well as the effect of the ash on the number of shoots, the growth and the element content in the test plants.

Materials and methods

Soil samples collected from the first plot of Westsik's crop rotation long-term field experiment. The soil of the experiment is a loose sandy soil, slightly acid, low in OM. Bioash originated from Alfen Ltd., Almásfüzitő, chopped wood used by the heating facility. The *1. Table* contains the main chemical properties of soil and bioash.

 DOI:10.12666/Novenyterm.65.2016.Suppl

1. Table: Chemical properties of soil and bioash

Sample	pH(KCl)	Humus m m^{-1} %	Ca mg kg^{-1}	P_2O_5 mg kg^{-1}	K_2O mg kg^{-1}
Soil	5.26	0.76	1280	54.3	93.5
Bioash	13.0		116000	1060	4730

Each pot contains 800 g soil. 1 g (550-600 grains) Ryegrass (*Lolium perenne*) or 25 grains of white mustard were seeded to the pots. The used treatments in ryegrass experiment: 0, 1.29, 6.21, 10, 20, 30, 40, 50, 60 t ha^{-1}, and in white mustard experiment: 0, 1, 5, 10, 20, 30, 40, 50, 60 t ha^{-1}.

The pot experiment were carried out on three replicates and the results were statistically tested. We used a program for ANOVA which made by Laszló Tolner in Microsoft Office Excel. This program was created by an algorithm of János Sváb (Sváb, 1981). This algorithm has been successfully applied in several studies (Kovács et al. 2015, Tolner et al. 2015).

Results and discussion

Bioash treatments have effect on ryegrass dry matter production ($p<0,1\%$). The one way variance analysis showed that the amount of ash dosage till 10 t ha^{-1} increased, 10-40 t ha^{-1} the effect is stagnate, over 40 t ha^{-1} decreasing tendency was measured in dry matter content (*1. Figure*).

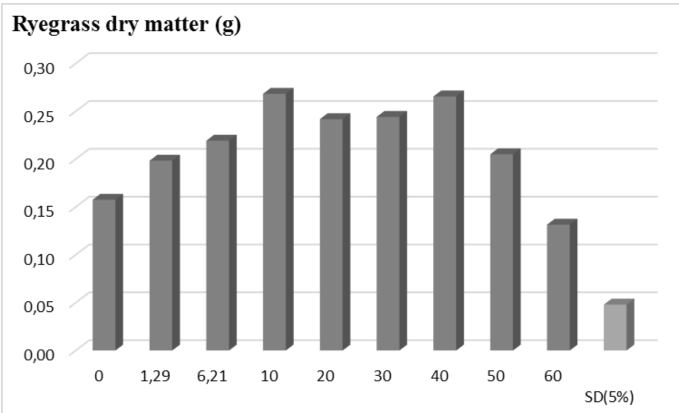


Figure 1. Effect of bioash treatments (X axis t ha^{-1}) on ryegrass yield

We studied, what kind of connection can be between the ash treatments and the dry mass production. The points are represent on the chart (*2. Figure* points), and we found that a asymmetric maximum function shape curve can be fitted on it (*2. Figure* line).

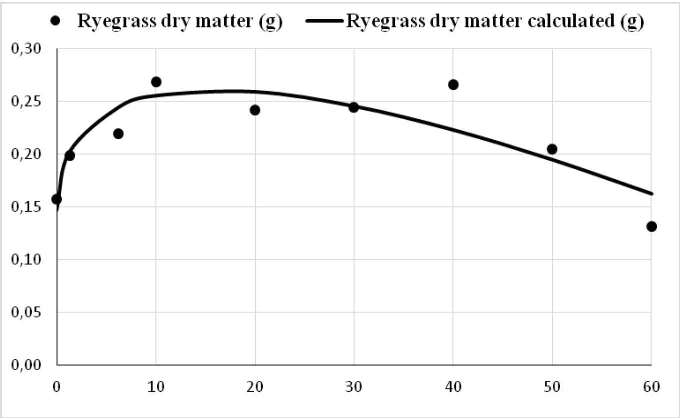


Figure 2. Connection between the ash treatments and dry matter production (X axis - bioash (t ha^{-1}).

Mathematical form of function:

$$y = a * x + b * \sqrt{x} + c$$

Calculation of parameters (a, b, c) made by fitting a curve of second degree after this transformation was used:

$$u = \sqrt{x}$$

The transformed function:

$$y = a * u^2 + b * u + c$$

Representing the dry mass production with this function „u" we got the point around a more symmetrical maximum curve (*3. Figure*).

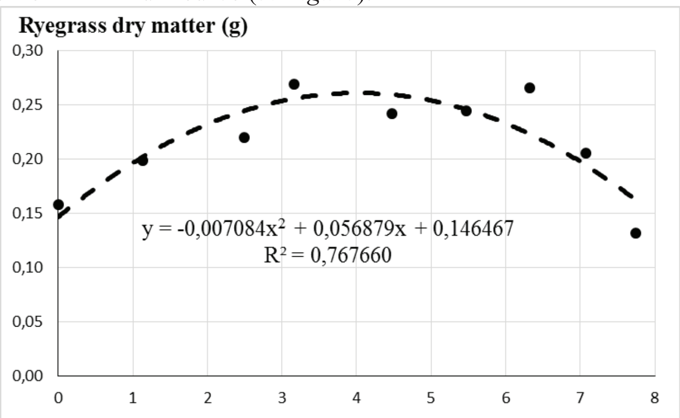


Figure 3. Transformed connection between the ash treatments and the dry mass production. (X axis - square roots of amount of bioash (u)).

Using Windows Excel's trend function of second degree we got the curve of function (*3. figure* broken line) and the equation (**3. Figure**). R^2 value reveals the proper fit.

$$y = -0{,}007084 * u^2 + 0{,}056879 * u + 0{,}146467$$

Maximum value can be determined by derivation. In maximum value the derivative of function equal zero.

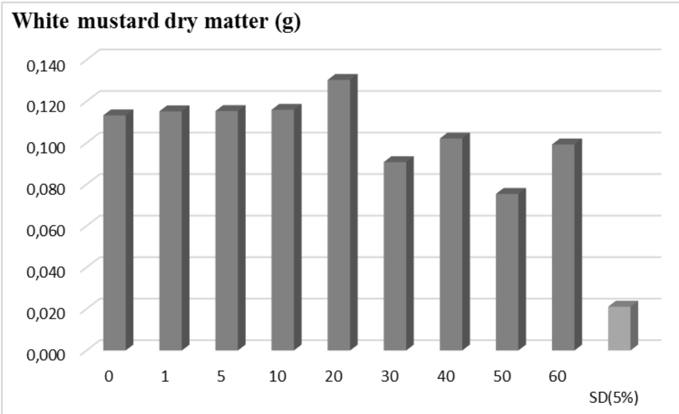
$$\frac{dy}{du} = -2 * 0{,}007084 * u_{max} + 0{,}056879 = 0$$

 DOI:10.12666/Novenyterm.65.2016.Suppl

U_{max} calculable with the equation. The result is 4.015. X_{max} is the square of it = 16.12. Calculated parameters (a, b, c) help to write the function of curve on *2. figure*:

$$y = -0,007084 * x + 0,056879 * \sqrt{x} + 0,146467$$

The effect on white mustard was consolidated (*4. Figure*).



4. Figure Effect of bioash treatments (X axis t ha^{-1}) on white mustard yield

Bioash has no significant affect below 20 t ha^{-1}, but the higher doses caused considerable decreasing and fluctuation.

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